3.0 The Role of the Regulator in the Safety Equation: A Canadian Perspective

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Introduction

The role of the regulator in the safety equation; what does this mean in the twenty first century? This paper addresses this issue from the perspective of the regulatory authority in Canada and the role we play in aviation safety. What should our contribution be? What are our responsibilities? And, how can we best meet these obligations?

To answer this question and explain the complexity of the regulator's position, I would like to share with you a quote by the author Isaac Asimov:

> "It is change, continuing change, inevitable change, that is the dominant factor in society today. No sensible decision can be made any longer without taking into account not only the world as it is, but the world as it will be. . . . This, in turn, means that our statesmen, our businessmen, our everyman must take on a science fictional way of thinking."

In effect, what Asimov is trying to say is that everything is in a state of flux and that the only way to handle the constant change is to apply predictive powers of reasoning to today's issues. We must anticipate the impact that current events will have on the industry and formulate our strategies to predict the ensuing changes. If we take this one step further and apply this to civil aviation in general, we can anticipate several circumstances that will impact the way the industry will evolve. These include: increased flight departures, increased competition in the market place and demands for competitive pricing.

In Canada we are also experiencing a merger of the country's two principal airlines; a move that will no doubt impact the nature of civil aviation in Canada for years to come. We know that air travel is increasing; indeed flight departures are expected to more than double in the next twenty years. We also know that competitive pricing in aviation means that other areas of the operation have to be streamlined. Overarching all of these issues is the question of safety; which, from the regulator's perspective, is the reason for our existence.

If our raison d'etre is aviation safety, then our objective, from the Canadian perspective, is to have the world's safest transportation system. This is an all encompassing statement for the industry and Civil Aviation as a whole. The achievement of this goal will take a collective effort from all involved. From the regulatory perspective this will start at the micro level - in Transport Canada that is the Branch. This paper looks at the initiatives taken by the Aircraft Maintenance and Manufacturing Branch that will contribute to the attainment of this goal and in the process will assesses the role of Maintenance and Manufacturing, ergo the regulator, in the safety equation.

What are the goals?

In determining the most effective way to contribute to increasing the already high level of aviation safety in Canada, we had to balance a number of factors. First of all, we looked for the root cause of the majority of maintenance errors that

lead to aviation incidents and accidents and found a common thread - the human element. Indeed, it has almost become standard to suggest that 80-90% of accidents are due to human error, and why not, when you consider that there is usually always some level of human-machine interface in everything we do. This assumption also leads to the belief that unsafe acts take only one form, when in truth there are many factors that contribute to human error.

What is a reality, is the fact that in most cases accidents occur from a linked sequence of failures. They occur in all parts of the system and hence require different types of "management". A failure in defenses, safeguards, barriers and controls highlights why a systemic, rather than an individual approach to safety is required. The intention is not, however, to remove the focus from the individual, but merely to demonstrate how human performance is impacted by other "uncontrollable" elements of the system. It might be that the human error is the active failure within the system, however, other latent conditions may have allowed the active failure to occur. In other words the defenses, safeguards, barriers and controls within the system either failed to prevent the error or combined to make the error possible.

The issue for the Branch then was deciding what role we should play in the prevention and mitigation of human errors in aviation maintenance. To decide this we looked for commonalties in an effort to determine the most effective way of addressing the issue. In a representative study of the top four causes of on-board fatalities it was determined that maintenance and inspection accounted for 24.4% of the on-board fatalities in the sample. If we look at other examples, maintenance related events are known to play a role in between 6-25% of all aviation accidents. When we mix the issue of non-reporting of incidents into this equation, that is incidents that occur and are not reported because they are considered insignificant or didn't result in an accident, these figures become even more dramatic.

The most common type of maintenance error is omission, or a failure to carry out necessary parts of the task. Omissions can involve the failure to replace some component, or the failure to remove foreign objects, such as tools, before leaving the job. So, what are the types of things that get omitted? The most common type of omission is fastenings left undone or incomplete. Other problem areas are items left locked or pins not removed; filler/breather caps loose or missing; and items left loose or disconnected. These are tangible and correctable problems. Problems that can be resolved with the correct procedures and a proactive safety program in place.

Why Now?

There are several motivating factors that encouraged the Branch to pursue a rigorous regulatory and educational program to address the issue of human error. The global fleet of aircraft is expected to double by 2015, and with the corresponding increase in departures, it can be reasonably anticipated that there will be an increase in aviation accidents. Another motivation is our desire to comply with the ICAO human factors training requirements.

Finally, Transport Canada Civil Aviation has produced a document called Flight 2005 identifying our operating principles and values, and describing our strategic direction for the next five years. Perhaps more importantly, Flight 2005 provides specific safety targets and shows what our key results will be. This is significant because it allows us to measure and quantify the results of the individual initiatives that will contribute to the attainment of these goals.

The Regulator's Role

So what is the regulator's role in the safety equation? Where do we fit into the grand scheme of things? To answer this we have to look at our raison d'etre: "Safety first and foremost". Our aim is to encourage improvements in safety levels through proactive management rather than reactive compliance with regulatory requirements. As aviation organizations generally possess an in-depth knowledge of the risks inherent to their operations, they are well placed to manage them and to achieve positive shifts in their safety culture. Transport Canada's role is to provide these organizations with information on the safety management concept and to facilitate its implementation.

The Human Versus System Approach to Managing Safety

Lewis Thomas, the physician and educator once stated "we are built to make mistakes, coded for error". Unfortunately, fallibility is part of the human condition, and the reality is, we are not going to change the human condition.[1] Moreover, the "hands-on" nature of maintenance related work means that aviation maintenance workers are more likely to be susceptible to human performance problems of one kind or another. Most maintenance related work requires some level of disassembly, if we think back to the most common maintenance error - omissions, the relationship becomes clear.

So what can we do about it? Well, we can change the conditions under which people work to help mitigate the propensity for error. We can analyze the inherent risks associated with the processes and procedures that must be followed to get the job done and work towards ameliorating the risks. In some cases this may involve rewriting job cards so they are simpler to understand, in others it may involve better lighting or the correct tool to complete the job. Whatever the solution, there are things we can do to decrease human error.

Scope of the Program

In view of this, we decided to attack the problem with a combination of training and new regulations that we believe most effectively address those areas that impact human performance: the individual; the organization; and, management. We address the individual through human factors awareness and technical training; the organizational issues by looking at elements such as equipment, procedures and the environment; and finally, we look at the role of management as an integral part of the safety equation.

We recognize that there is no magic solution; nor is there any best combination of measures. These regulations establish the framework, if you will, for each organization to meet the requirements in the manner that best meets its own circumstances. In reality, effective error management requires different measures targeted at different levels of the organization: the individual, the team, the task, the workplace, and, the system at large. Different combinations suit different organizations. The challenge for each individual company is to match its safety portfolio with its company culture.

The regulatory format in Canada, "performance based objective", offers the industry the flexibility it needs to meet this challenge. Inasmuch as Transport Canada sets the objective, it is left up to the discretion of the individual organization to determine the most appropriate way to meet this requirement. In this way, the company can mix and match its program to achieve maximum effectiveness.

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[1] Reason, James. *Managing the Risks of Organizational Accidents*. (Aldershot: Ashgate Publishing, 1997), pp. 79-82.

Regulatory Initiatives

The regulatory package tabled at the Canadian Aviation Regulation Advisory Council (CARAC) Technical Committee has three components: human factors training; the accountable executive (both of which are applicable to all operators and approved maintenance organisations); and, the maintenance safety program which applies to Transport category and commuter category operators only. This is a complete regulatory package, that in effect constitutes a hazard management methodology.[2]

In terms of human factors, we realize that addressing human error begins with an understanding of those issues that detract from optimum human performance and that human factors training is the most effective way of dealing with this. However, if our sole focus is the individual we do not get at the systemic factors, such as the organization, facilities, shift management and resources that often create the latent conditions that lead to errors. Furthermore, we have introduced the concept of the accountable executive, thereby ensuring that the Certificate holder or a person appointed by the Certificate holder is held accountable.

The second phase of our regulatory package, the maintenance safety program[3], as a limited application in that it applies to the Commuter and Transport category rated air operators and AMOs working on aircraft eligible to operate in the Transport and Commuter categories only. Our aim is to provide a performance based regulation that allows for the development of an internal system of on-going review, data collection, analysis and corrective actions that reduce the propensity for human errors that can lead to incidents and accidents.

The Existing Situation

In accordance with the Canadian Aviation Regulations (CARs), most air operators and approved maintenance organisations will already have some of the tools that constitute a safety management program in place or available to them. On the operations side we have traditional flight safety operations and on the maintenance side we have traditional quality assurance programs.

A traditional quality assurance system deals with the organizational issues required to ensure consistent production. Safety management looks at the potential for human error within the system and provides for proactive measures to catch errors before they become incidents or accidents. In effect, safety management is quality assurance wrapped in a human factors blanket.

The Maintenance Safety Program

Our intent is to merge the basic elements in these programs to create the maintenance safety program requirement. The following list contains some of the highlights of what is involved. In addition to the existing quality assurance requirements defined in the CARs, a maintenance safety program includes:

- A maintenance safety management plan;
- Safety management training requirements;

[2] Shell Aircraft, *Making the Safety Case: Aviation Safety Management Policy*. January 2000.

[3] Throughout the body of this essay the terms Maintenance Safety Program and Safety Management System are used interchangeably. Maintenance Safety Program is the name chosen by the CARAC Technical Committee to define the safety management concept.

- Data collection & Incident analysis procedures;
- Reporting procedures;
- On-going internal audits; constant upgrading of system in pursuit of excellence;
- Independent corrective action determination;
- Independent implementation of corrective action recommendations; on-going observation and evaluation of corrective actions.

Another component of the maintenance safety program is data collection and incident reporting. This is important for numerous reasons, not the least of which is the constant feedback from the workplace on existing and emerging unsafe conditions. Most error management systems are reactive rather than proactive; they focus on active failures rather than the latent problems within the system. Workers on the shop floor are ideally positioned to recognize these situations, however, without an efficient data collection and incident recording system this knowledge is lost. Once in place, the system must provide for employee feedback in the form of an acknowledgment that the report has been received, a report of the result of the incident analysis, and a progress report of any corrective action that has been taken.

Individual responsibility for the system rests with the quality assurance manager. However, he/she is only responsible for identifying the deficiencies in the system and not the solution to the problem. All corrective action decisions remain independent of the maintenance safety program manager. Although the program manager may offer technical advice regarding possible solutions to the problem.

Essentially, the maintenance safety program manager's duties include:

- The establishment of a reporting system to collect maintenance safety related information;
- Hazard identification and risk management analysis of whole organization;
- Safety audits;
- Investigation, analysis, and identification of the root cause of all incidents, accidents and safety deficiencies identified by the program;
- Monitoring and evaluation of the results of maintenance control safety initiatives.

The Quality Assurance Link

Having discussed the various elements of the maintenance safety plan, I would like to emphasize the importance of the quality assurance link in the safety equation. In his book, *Out of Crisis*, J.W. Demming states that "the components of the system that are responsible for its capability, and hence its results, are people, equipment and environment." Demming believed that management is solely responsible for each of these components and because these components determine product quality, management is also responsible for quality.

To put this in context of the regulatory requirement, by adding the quality assurance component to a flight safety program weaknesses in the system that might have the potential to impact safety, people, equipment and environment are discovered through incident reporting, data, analysis, risk assessment and on-going safety audits.

By combining flight safety and quality assurance into a safety management system, it could be argued that four benefits not usually found in the typical aviation safety tools are generated. Firstly, an independent check and balance of all corrective actions is introduced. Secondly, a proactive element is added to the system. Instead of waiting for problems to occur, safety management allows the organization to anticipate possible "hot spots" and deal with them before they become problems. Thirdly, accountability at the top level of the organisation means that management assumes

responsibility for each component of the system. Ergo, the safety of the system. Finally, the application of safety management principles forces one to look at the potential for human error within the system and not just the potential for product defects within the system. In effect, the focus switches from looking solely at production, to looking at the entire system. How we achieve the end product becomes as important as the end product itself.

The Accountable Executive

As previously stated, all corrective actions are conceived outside of the maintenance safety program. Usually, these decisions will be made through a safety committee or by the director of maintenance. A basic tenet of safety management, however, is that there has to be a top down commitment to safety. To ensure that upper management knows and understands the issues that might impact safe operations, the director of maintenance must notify management of any issues that might affect safety.

To further entrench the notion of top management accountability we have introduced the concept of the accountable executive. The accountable executive is, to all intents and purposes, the certificate holder. In fact, in a whole proprietorship he will almost certainly literally be the certificate holder. In a corporation, he will most likely be the CEO or a senior executive who has been delegated authority similar to that of the CEO. This is not just a manager with a big budget, therefore, this is someone at a level that determines how big the various departmental budgets will be, with full executive control over the organization's activities.

The reason for specifying a single accountable executive for all certificates held by a company, is to ensure that this responsibility is not simply delegated to the various functional heads responsible for the different certificates. After all, this individual may have to decide whether, for example, to divert funds from new aircraft acquisition, to new hangar construction, or from training to test equipment.

Human Factors Training

Rounding out the regulatory package is the requirement that all personnel, with technical responsibilities, are to be provided with human factors training. Human factors training shall include the following subjects:

(a) Human performance;
(b) Factors influencing human error including areas such as: fatigue, communications and teamwork;
(c) Error management, including error mitigation and error containment.

Recurrent human factors training requirements will be determined through an analysis of all incidents, accidents and safety deficiencies identified through the maintenance safety program.

In order to satisfy this requirement Transport Canada has developed a Human Performance in Aviation Maintenance training course. We intend to provide the same support for those companies that are required to implement a maintenance safety program within their organization.

Where do we go from here?

Most people have heard of the concept of continuous improvement. Having introduced these measures we cannot afford to rest on our laurels in the belief that we have "done our bit for safety". Indeed, we must continuously strive to

enhance safety. "Wisdom lies neither in fixity nor in change, but in the dialectic between the two."[4] We must continue to work with industry to improve safety. As I mentioned earlier, the status quo will not do and the only real means to achieve an increased improvement in the accident rate is to address the prominent cause - the human factor.

Accordingly, I would like to discuss some of the upcoming initiatives that we believe will enhance safety and assist the industry. First of all, we intend to review the issue of duty time limitations for maintenance personnel. It is our intention to launch a comprehensive study of maintenance personnel duty times. Before we make any decisions regarding duty times, however, the Aeronautics Act will need to be amended. Of course, we do not intend to do this in isolation we will involve industry and all of our stakeholders in this process with a view to determining the most effective course of action. This might involve regulation; on the other hand it may be that education and awareness programs are the most effective way of addressing this issue.

We are also committed to supporting the aviation industry in their efforts to implement maintenance safety programs through the development of advisory material and training programs to support the maintenance safety program requirement.

Conclusion

There is a challenge ahead for the regulatory authorities in Canada and around the World if we are to achieve a steady decline in the accident rate. We believe we have made a good start in meeting the challenge and have responded in a proactive way to this formidable task. However, when one attempts to predict the future, there is always the possibility that what we put in place now, may not be appropriate in years to come. This is why we've made the program flexible enough to account for irregularities and will review the regulations, training and awareness programs for currency when necessary. The regulatory framework we have created encourages the adoption of safety management principles in non-prescriptive way. We provide sufficient flexibility for organizations to meet the requirements in a way that is best suited to their physical, philosophical and geographic realities.

We know of course that safety cannot be regulated; safety management involves a top down commitment to safety first and foremost. A safety culture doesn't just happen, it has to be nurtured and empowered by the total commitment of the company to do whatever it takes to improve safety. This involves training, awareness, compliant behavior and the adoption of a safety program that will provide the tools necessary to identify and correct safety deficiencies.

Theories abound as to the best way to achieve a safer aviation system, however, "an ounce of action is worth a ton of theory"[5] and at some point we have to put the theory into practice. So, what is the role of the regulator in the safety equation? As the regulatory authority it is our responsibility to provide the safety framework through initiatives, such as the maintenance safety program, the accountable executive and the human factors training program, that establish the baseline for improving aviation safety. We have to continue to work with industry in a collaborative effort to achieve the *safest possible transportation system in the world.*

[4] **Octavio Paz**. *Times* (London, 8 June 1989).

[5] **Friedrich Engels** (1820–95), German social philosopher. Quoted in: Reg Groves, *The Strange Case of Victor Grayson,* ch. 2 (1975).